

The taxonomy of *Moschus* (Mammalia, Artiodactyla), with particular reference to the Indian Region¹

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(With a plate)

Survey of literature and of available museum specimens shows that the three-species concept of *Moschus*, proposed by Flerov, is a valid one. Two of the species extend into the Indian region, *M. sifanicus* in the alpine zone and *M. chrysogaster* in the wooded lower slopes. The differences between the two are described and a taxonomic revision of the genus is proposed.

The lack of attention, in recent years, to questions of the taxonomy of larger mammals, especially ungulates, should not be taken as an indication that all problems in this field have been solved. As this paper intends to show, there are still many questions that are wide open, although plausible cases can be made out for a new look at old "certainties".

The Musk Deer of Asia has been accepted by most standard works, from Lydekker (1915) through Allen (1940) and Ellerman & Morrison-Scott (1951) to Heptner *et al.* (1961), as comprising a single species, *Moschus moschiferus* Linnaeus, 1758. However, as early as 1928 Flerov had doubted that such a scheme adequately expressed the complexity of the situation, and in spite of some cold water thrown on this view by Allen (1940), he renewed his three-species view at a later time (Flerov 1952). Lately, renewed collecting in China led Kao (1963) to support Flerov's scheme, again with modifications.

Flerov's first classification (1928) divided *Moschus* into three species:

M. moschiferus Linnaeus, 1758. Siberia, Korea, Manchuria. 5 sub-species recognised.

M. chrysogaster Hodgson, 1839. Northern India, Nepal, Kansu and

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Szechwan. 2 subspecies recognised.

M. berezovskii Flerov, 1928. Szechwan. Monotypic.

In this scheme, the first species is allopatric to the other two, which either overlap or approach each other's range in Szechwan—*M. berezovskii* being confined to alpine pastures, *M. chrysogaster* occurring throughout the forest zone of the west-Chinese mountain slopes, as well as in the Indian region. His scheme was presented in greater detail in a later paper (Flerov 1930).

In his later revision (Flerov 1952) he somewhat changed his opinion, reducing the number of subspecies and rearranging the nomenclature. Whereas earlier he had given the type locality of *Moschus moschiferus* as "Russian Altai" (from Linnaeus's "Tataria versus Chinam"), he now stated baldly that the species had been described from a northern Indian specimen. The name *moschiferus* thereby took precedence over *chrysogaster*, while the Siberian musk-deer must take the next available name (*sibiricus*). The three species were:

M. sibiricus Pallas, 1779. Only two subspecies.

M. berezovskii Flerov, 1928.

M. moschiferus Linnaeus, 1758. Two subspecies.

In the blitz on subspecies, *M. m. arcticus* described by himself (1928) had been synonymised with *sibiricus* as had *parvipes* Hollister, 1911 and *turowi* Zalkin, 1945, with the only valid subspecies (the nominate race apart) in that species being *sachalinensis* Flerov, 1928 from Sakhalin island; within the species previously called *M. chrysogaster* but now *M. moschiferus*, Flerov continued to uphold *sifanicus* Büchner, 1891 as a valid race.

Kao's approach (1963) differed from Flerov's in its more limited scope. It would seem that Flerov had mostly specimens from Soviet territory, with a few from China; Kao's were all from China, and there was no attempt to link them to forms described from outside Chinese borders, except that the Manchurian musk-deer was referred to *M. moschiferus*, rejecting Flerov's revised interpretation. The three species recognised were:

M. moschiferus sibiricus Pallas, 1779: Manchuria.

M. berezovskii Flerov, 1928: wooded zones from Szechwan to Kwangsi.

M. sifanicus Büchner, 1891: alpine zone of western China.

The most remarkable change is here that the ecological relations of *berezovskii* and *sifanicus* are reversed from the conception of Flerov. Flerov had stated, on Büchner's authority, that the dwarf *berezovskii* lived in the alpine zones, with *sifanicus* in the montane woodlands of the slopes. It is clear from Kao's statements that Büchner had been in error. Kao writes (translation kindly arranged by Dr Robert Hoffmann, University of Kansas Museum of Natural History):

Habitat of *sifanicus* is the high plains of Tibet and Ching-hai, for the most part 2000 to 3000 or even 4000 metres above sea level. . . . In the west of Szechwan in the perpendicular interlocking areas with the forest musk deer, they are certainly the most abundant musk deer type. A cross section of the said perpendicular interlocking areas extends north to the grassy plains and marshland of the pine forests of Te-lu, Szechwan, and southward to the high mountain areas of Te-chin, Yunnan, at 3500 metres above sea level.

He says that *sifanicus* is called Ma-chang (horse-roebuck), and is unanimously affirmed by hunters to live in high mountains; the small, dark *berezovskii*, Lin-chang (Forest-roebuck) live in low mountains.

The specimens obtained by Kao and his colleagues proved to be this way: big light-coloured animals in the alpine meadows, small nearly black ones in the forest. (It can be recalled that Engelmann (1938) had also given this distribution, on the field evidence of Schäfer, but without naming the two contrasting forms).

Thus the two species, *sifanicus* and *berezovskii*, overlap—apparently without interbreeding—from Mu-li (28.12 N, 100.50 E) and Li-t'ang (30.02 N, 100.18 E) in the south to Ma-erh-k'ang (not found) and P'ing-wu (32.30 N, 104.30 E) in the north. Beyond these areas, only one species or the other occurs: *sifanicus* at Te-lu (25.40 N, 103.42 E) and Te-chin (28.28 N, 98.48 E), *berezovskii* at Yen-yüan (27.30 N, 101.40 E). The latter species seems to extend westward into low-lying woodland areas: Kao records it from Kwangsi province at Ching-hsi (23.10 N, 106.28 E), Kweichow province at Kuei-yang (26.35 N, 106.40 E) and Shensi province at Mei hsien (= county), 34.12 N, 107.50 E. In the British Museum (Natural History) are two specimens referable to *berezovskii* from Ichang (30.43 N, 111.22 E), also a low-land locality.

The three species occurring in China may be described as follows (using Kao's nomenclature for the moment):

1. *M. moschiferus* (extending south probably to the Hwang-ho): a large species; dark brown, usually spotted; two white stripes on lower part of neck, extending to shoulder. Ear-backs dark. Individual hairs are grey-white for two-thirds of their length, then brown-grey, with a darker brown tip; commonly there are whitish rings near the tips, which, when clumped, give the overall spotted effect. The fur is soft compared to the other two species, 45-60 mm long on the withers, 65-75 mm on the rump (in the Siberian race; but in Korean skins these lengths amount to only 34-37 mm and 45-62 mm respectively). In the skull, the halfway point falls within the orbit or at its anterior border; the lacrimal is at least as broad as long; the supraorbital arches do not extend above the dorsal outline of the skull.

2. *M. berezovskii*. A small species, but not smaller than the Korean race of *moschiferus*; very dark, olive-brown with nearly black haunches and buttocks; no spots; underside of throat and breast light to white.

Ear-backs dark, blackish. Individual hairs are grey at the base (over about a third of their length), with the shaft dark brown, and a reddish yellow ring near the tip. The fur is harsh, 38-50 mm on the withers and 48-70 mm on the rump. The skull is very like that of *moschiferus* but has a relatively shorter braincase.

3. *M. sifanicus*. Large; light in colour, sandy yellow or light brown (Kao); no spots except for a few vague ones on dorsum; yellow or white below. Ear-backs with broad yellow zone at tip. Individual hairs lead grey at base, light brown on most of shaft, an orange or yellow ring, then a dark brown tip. Fur harsh, 31-46 mm on withers and 45-68 mm on rump. Skull differs from that of the other two in its long face, with the skull midpoint falling forward of the anterior orbital margin; lacrimal longer than broad; supraorbital arches well-marked, rising above dorsal outline of skull.

These descriptions are taken from Flerov, as modified by Kao. As far as the British Museum materials extend, however, they confirm the literature findings. Specimens of *M. moschiferus* are fairly plentiful; in addition to the B. M. material there is a series of adults and young in the Zoological Museum, Berlin, from Lake Telezker (= Teletskoye), in the Altai, while Egorov (1965) gives detailed descriptions of musk-deer from Yakutia, with comparisons of series from Tokko River (57.30 to 60.00 N, 120.00 E) and the Verkhoyansk range, which differ weakly. Kao's paper includes descriptions and measurements of specimens from Heilungkiang and Kirin provinces. From all these data it is possible to see a broad division of the species into two subspecies, apparently distinct enough though not recognised by Flerov (1952):

1a. *M. m. moschiferus*. Occupying the northern and western parts of the range, the Altai and Sayan ranges, Yakutia north to the type locality of Flerov's rejected race *arcticus* (Mt. Toulaiakh-kaia, Northeastern Tashkhaiakhtakh range, about 68.00 N, 139.00 E). To judge by the measurements provided by Kao, specimens from I-ch'un, northern Heilungkiang (47.41 N, 129.10 E), would be referable to this subspecies though tending towards the next race in their short lacrimals and presumably—since no colour differences are mentioned from other Manchurian examples—in their dark colour. In this race the colour is dark brown to light grey-brown, the hair-bases whitish; the size is large (skull length as in Table 1, metacarpal and metatarsal lengths respectively 128-148 and 172-189 mm. (Flerov 1952)); the lacrimal is long, often slightly longer than broad; the nasal bones form a wedge into the frontals behind.

1b. *M. m. parvipes*. From the Soviet Far East (Amur-Ussuri district) and Korea, extending into Kirin province and southern Heilungkiang (localities, in Kao's paper, Shang-chin (45.13 N, 127.59 E) and Lake Ching-po-hu (about 44 N, 129 E)). This is decidedly smaller;

for skull measurements see Table 1; metacarpals 125-128, metatarsals 166-170 (Flerov 1952); lacrimal short; nasals abbreviated behind, not wedge-shaped. The colour averages darker with the hair-bases grey; but some specimens of similar colour can be found amongst the lighter individuals of the nominate race (such as the type of *arcticus* Flerov). It is a puzzle why Flerov (1952) no longer recognises this present race, though it is retained by Heptner *et al.* (1961).

A third subspecies, not seen by me, is recognised by Flerov (1952) and Heptner *et al.* (1961):

1c. *M. m. sachalinensis*. The description of this race recalls *parvipes* very closely except in one respect: that the interorbital breadth is less than the postorbital breadth, the opposite to the condition in both other forms. Otherwise it seems virtually indistinguishable. It is confined to Sakhalin island.

MUSK-DEER OF THE TIBETAN PLATEAU

The two species *berezovskii* and *sifanicus*, which overlap without interbreeding (according to Kao) in Szechwan, are poorly represented in collections in the West. The British Museum has the following specimens:

3.5.15.6. "Szechwan". Medium to dark greyish; ears dark, nearly black, throughout. No skull. Clearly represents *berezovskii*.

1.3.2.6. Ichang (young). Pepper and salt grey, very coarse-haired; the dark bands on the hairs nearly black; ears dark grey becoming black at tip. Skull has *berezovskii* characters.

1.3.2.3. Ichang (adult). Skull only; typical *berezovskii*.

11.9.8.144. Wen Chuan, Szechwan (31.29 N, 103.40 E). Young: Third molars not yet broken through. Dark greyish, with blackish bands on the hairs; ears dark. Skull typically *berezovskii*.

11.2.1.265. Tau-Chou, Kansu (perhaps T'ao Chou, now Lin t'an, 34.39 N, 103.40 E); young, similar to last in age. Light grey brown; ears with broad yellow tips. Skull broken, but lacrimal certainly much longer than broad. This is obviously *sifanicus*; altitude "8,500 feet".

18.10.8.1. Shigatse. Slightly darker than the last but still noticeably lighter than the first few skins. Ear yellow near tip. Skull typically *sifanicus*.

Apart from these six, there is a skin from "S.E. Tibet" which is an albino, and nothing more can be said about it; and a skull with no skin from "N.E. Peling Mts", probably a young *berezovskii*; this may be Mt. Pai Ling in Kwangsi at 23.20 N, 105.50 E. It will be seen from Table 1 however that two Kwangsi skulls of this species—according to the data of Kao and of Wang *et al.*, 1962—are extremely small, and may

prove to represent a new subspecies: but if this surmise is correct, then the "Peling" skull cannot belong here as it is 145 mm long, though immature.

It is clear in any case that the two Tibetan-plateau species can be distinguished on the basis of museum material as well. For the figures in Table 1, specimens of *sifanicus* from Ta-t sien-lu in the Paris Museum have been included, and specimens of *berezovskii* from Wen-chuan-hsien in the American Museum of Natural History (kindly communicated by Dr G. G. Musser).

MUSK-DEER OF THE INDIAN REGION

It has been shown above that the concept of two species of Musk-deer of overlapping distribution, differing in ecological requirements, is a valid one for the montane region of western China. The problem is now to allocate the musk-deer of the Indian region: India, Nepal, Sikkim and Burma (Bhutan being unrepresented in collections). Flerov assumed throughout that it is *sifanicus* which is represented in the Indian region, but as we have seen his concept of that species was in error; moreover he is unlikely to have had more than one or two specimens to work with (for example, he in no case gives skull measurements).

The specimens in the British Museum (Natural History) amount to the following: Skins with skulls, 2; skins alone, 5; skulls alone, 11. In addition there is 1 skin with skull, and 5 skins alone, in the collection of the Bombay Natural History Society. (This list excludes specimens without locality). Two skins without skulls from Burma—one in London, one in Bombay—will be treated separately.

A brief description of each specimen follows:

a. London, BM (NH): Skins and skulls.

43.1.12.93. "Nepal"; type of *chrysogaster* Hodgson, 1839. Medium to dark yellow-brown, apparently slightly faded from the "bright sepia" of Hodgson (1839). Ears dark throughout. Skull length 152 mm; lacrimal somewhat longer than broad; supraorbital arches not elevated; midpoint of skull within orbit. Except for the lacrimals, and perhaps the rather larger skull, all of these features correspond with *berezovskii*.

15.9.1.238. Lachung, Sikkim, 8,800'. Head-skin only; ears brown with clear light, yellow rims. Skull length 164 mm; lacrimal much longer than broad; supraorbital arches somewhat elevated above dorsal outline; midpoint in front of orbit. All these features resemble *sifanicus*, but the restriction of the yellow zone to the rims of the ears is different.

b. BM (NH): Skins only.

43.1.12.95. "Nepal"; type of *leucogaster* Hodgson, 1839. Less yellow than *chry-*

sogaster but otherwise very like it, with dark ears. In the catalogue of Lydekker (1915) this specimen is stated to have a skull, but it does not today.

91.10.7.175. Sikkim. Very dark brown; ears entirely dark.

91.10.7.174. Sikkim. Nearly black. Ears dark.

8.2.29.4. Rishi Nala (perhaps in region of Rishikesh?), Garhwal, 12,000'. Grey brown; ears with light rims like the Lachung specimen.

39.833. Chamba. Brown-grey, limbs somewhat greyer; vague traces of spotting on back. Ears with light rims.

c. BM (NH): Skulls only.

91.8.7.221. Kashmir. Length 150 mm; lacrimal somewhat longer than broad; midpoint in orbit; arches not much elevated.

91.8.7.222. Kashmir. Incomplete; lacrimal longer than broad; arches somewhat elevated.

30.1.2.57. Length 155 mm; lacrimal longer than broad; midpoint in orbit; arches not elevated.

43.1.12.98. "Nepal"; type of *saturatus* Hodgson, 1839. Length 159 mm; lacrimal longer than broad; midpoint in orbit; arches not elevated. Hodgson describes the skin as "Dusk brown"; by the time Lydekker compiled his catalogue of British Museum mammals (1915) the skin was no longer in the museum.

678a. "Nepal". Length 151 mm; lacrimal longer than broad; midpoint in orbit; supraorbital arches not at all elevated.

48.6.11.26. Length 149 mm; lacrimal slightly longer than broad; midpoint in orbit; arches somewhat elevated.

6168c. Lachen, Sikkim, 8,000'. Length 148 mm; lacrimal longer than broad; midpoint in orbit; arches not elevated.

43.1.12.97. Cachar; type of *cacharensis* Lydekker, 1915, nom. nud. (ex Hodgson ms.). Length 150 mm; lacrimal somewhat longer than broad; midpoint in orbit; arches slightly elevated.

47.325. Sikkim, 11,000'. Length 155 mm; lacrimal much longer than broad; midpoint well in front of orbit; arches elevated.

43.1.12.94. "Nepal". Length 163 mm; lacrimal much longer than broad; midpoint in front of orbit; arches elevated.

26.10.8.71. Jaunsar, U.P., 8,000'. (Locality not traced). Length 161 mm; lacrimal much longer than broad; midpoint well in front of orbit; arches strongly elevated.

d. Bombay Natural History Society.

17843. Konal Nullah, Kulu, 9,500'. Very dark colour; ears wholly dark. Skull length 158 mm; lacrimal somewhat longer than broad; midpoint on or in front of anterior rim of orbit; arches slightly elevated. The skin is clearly *berezovskii* but the skull would not be typical.

17844. Nepal. Dark brown; ears dark.

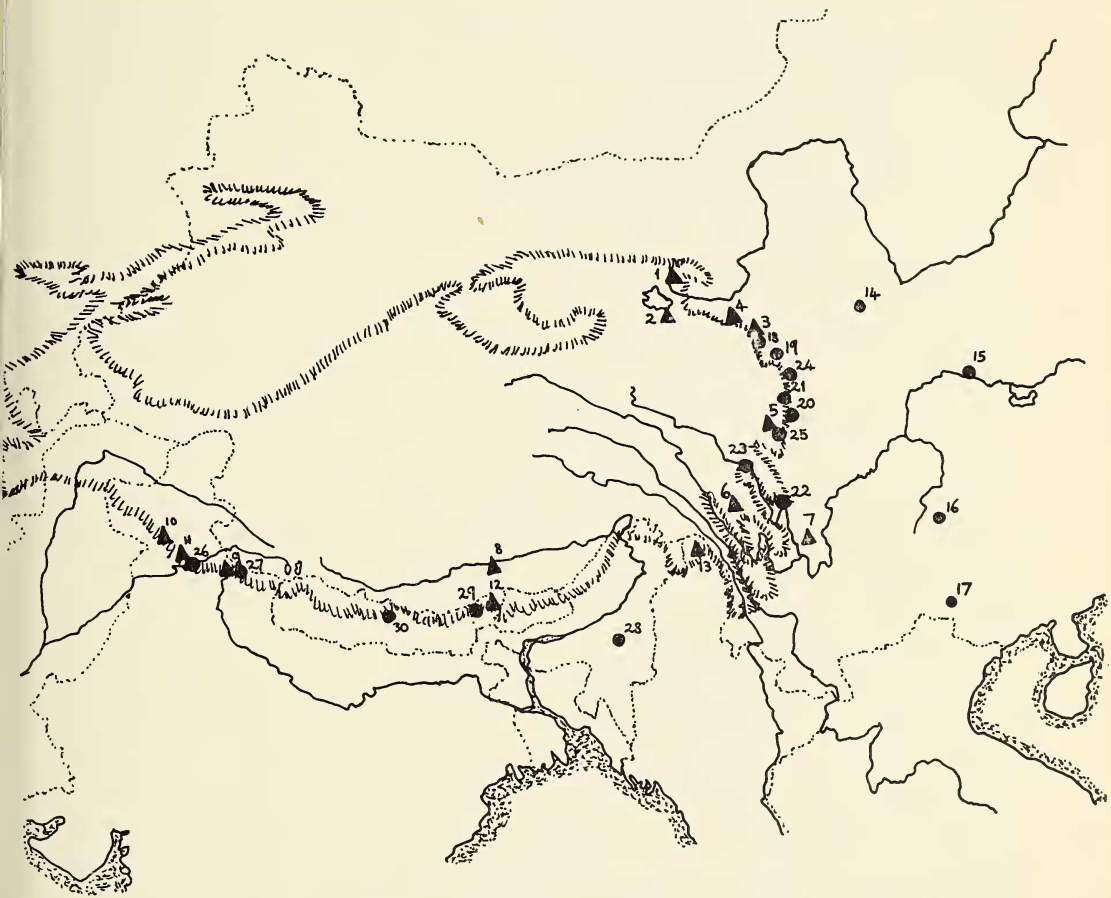
17842. Gorkha, Nepal. Dark chocolate-brown; ears dark.

17847. Garhwal. Rather dark brown. (Head missing).

(Display mounted skin). Kula valley, 9,000'. (This might be the Kula valley in Bhutan, near Monla Karchung, or more likely a lapsus for Kulu, 31.58 N, 77.06 E). Diffuse light pepper-and-salt greyish; ears light-rimmed.

17846. "Sikkim, Tibet". Light pepper-and-salt; light-tipped ears.

Two additional skulls should be mentioned, both from the Berlin collection, both subadult. 13483 from "Assam", nearly adult, has a length of 137 mm; lacrimal longer than broad; midpoint in skull; arches not elevated. No. A. 29.00



Map of the distribution of *Moschus sifanicus* and *Moschus chrysogaster*.

(For locality details, see overleaf)

Localities are as follows:-

M. sifanicus (triangles).

Chinghai:

1 Men-yuan	37.28 N,	101.50 E
Kukunorih	35.00 N,	101.00 E
2 Kung-ho	36.20 N,	100.46 E

Kansu:

3 Archuen	34.00 N,	102.00 E
4 T'ao Chou	34.39 N,	103.40 E

Szechwan:

Te-lu	?25.40 N,	103.42 E
5 K'ang ting = Ta-tsien-lu,	30.05 N,	102.04 E

Yunnan:

6 Te-chin	28.28 N,	98.48 E
7 Tien-chih	25.00 N,	102.40 E

Tibet:

8 Shigatse	29.18 N,	88.50 E
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M. chrysogaster (circles).

Shensi:

Shung-wang-heng	?	
Shun te-p'eng	?	
T'ai-pai-shan	?	
14 Mei hsien	34.12 N,	107.50 E

Hupei:

15 I-chang	30.43 N,	111.22 E
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Kweichow:

16 Kuei-yang	26.35 N,	106.40 E
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Kwangsi:

17 Ching-hsi	23.10 N,	106.28 E
Pai-ling	?23.20 N,	105.50 E

Kansu:

18 Archuen	34.00 N,	102.00 E
19 Sikou	33.50 N,	104.23 E

Szechwan:

20 Wen-chuan	31.29 N,	103.40 E
Cheng Wei	?	
21 Ma-erh-k'ang	31.34 N,	102.25 E
22 Yen-yüan	27.30 N,	101.40 E
Jang-t'ang	?	
23 Li-t'ang	30.02 N,	100.18 E
24 P'ing-wu	32.30 N,	104.30 E
25 Ta-tsien-lu,	30.10 N,	102.10 E

INDIA:

9 Rishi Nala = ?Rishikesh,	30.07 N,	78.19 E
10 Chamba	32.33 N,	76.10 E
11 Kula valley = ?Kulu,	31.58 N,	77.06 E
Jaunsar, U.P.	?	?

Sikkim:

12 Lachung	27.42 N,	88.48 E
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Burma:

13 Adung-seingku confluence and Dchpu L'kha; both	28.10 N,	97.30 E
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INDIA:

26 Konal Nullah, Kulu	?	?
27 Garhwal	30.20 N,	78.30 E
28 Cachar (Hills?)	25.30 N,	93.00 E

Sikkim:

29 Lachen	27.40 N,	88.36 E
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Nepal:

30 Gorkha	28.01 N,	84.37 E
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from "Calcutta", slightly younger (but with all teeth erupted) is 154 mm long; with midpoint in front of orbit and arches elevated (lacrimals are missing).

This list is an interesting one; unsatisfactory in that there are so few associated skins and skulls, but showing quite clearly the existence of two colour types: a dark type with dark ears, indistinguishable from the Chinese *berezovskii*, and a light type with yellow-rimmed ears, recalling *sifanicus* but not identical to it (ears only rimmed with yellow, not broadly tipped; colour perhaps greyer, less yellow).

The skulls cannot be so decisively placed in two groups. Without a doubt they are heterogeneous lot; for example, the length of fully adult skulls varies from 148 to 164 mm, a variation which cannot be ascribed to geographic variability as both largest and smallest skulls are from Sikkim! The lacrimal bone is almost always longer than broad, though the degree of excess varies. The position of the skull midpoint is probably the easiest character to use in a division of available skulls into two groups, as it divides the smaller ones (148-159 mm) from the larger ones (155-164 mm), with a weak correlation with degree of elevation of the supraorbital ridges and the degree of lacrimal elongation. In fact, all these features would tend to be correlated anyway: a larger skull would mean a longer face, so doubtless a longer lacrimal, and maybe a flatter interorbital surface giving added prominence to the supraorbital arches. That this correlation is not fundamental, however, is shown by the Siberian species: the same size as *sifanicus*, it yet has a more *berezovskii*-like skull, though perhaps less distinctive.

One concludes from the survey of specimens from the Indian region that there are certainly two species represented, and that they correspond to the two in the southern Chinese mountains. They are, as in China, sharply distinct on the evidence of their skins, but, unlike in China, not so distinct in their skulls. The explanation for this is evidently that the "cf. *berezovskii*" race is larger in India than in China, so that its other skull features would, by allometry, approach those of the "cf. *sifanicus*" form. The very large skull of the type of *chrysogaster*, a *berezovskii*-like type, confirms this, and the strikingly large skull of Bombay no. 17843 extends this conclusion.

In the list, the skins are easy enough to assign to one species or the other; as follows:

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|-----------------------------|---------------|---------------|---------------|
| 1. <i>cf. berezovskii</i> . | | | |
| 43.1.12.93. | 43.1.12.95. | 91.10.7.175. | 91.10.7.174. |
| Bombay 17843. | Bombay 17844. | Bombay 17842. | Bombay 17847. |
| 2. <i>cf. sifanicus</i> . | | | |
| 15.9.1.238. | 8.2.29.4. | 39.833. | Bombay 17846. |
| Bombay, display skin. | | | |

The skulls are plausibly divided as follows:

1. *cf. berezovskii*.

91.8.7.221.	91.8.7.222.	30.1.2.57.	43.1.12.98.
678a.	48.6.11.26.	6168c.	43.1.12.97.
2. cf. <i>sifanicus</i> .			
47.325.	43.1.12.94.	26.10.8.71.	

Of the two Berlin specimens, 13483 is certainly of the first type, A. 29.00 equally surely of the second. The basic division, for reasons explained above, has been made on the basis of position of skull midpoint, but the fact that in Bombay no. 17843, identifiable as type 1 on basis of the associated skin, the midpoint lies slightly forward of the orbital rim, dictates caution. One can however be reasonably certain of the correct allocation of the type 2 skulls: the smallest (47.325) on the basis of its 11,000-ft altitude (above the tree-line), the rest on the basis of their large size. Among the type 1 skulls, uncertainty must exist with the incomplete skull, 91.8.7.222 although its association in series with 91.8.7.221 renders its taxonomic association with it more likely; and the large skull, type of *saturatus*, must also be regarded as not certainly belonging here.

As would be expected from the ecological differences between the two, "*berezovskii*" has evidently been more easily obtained than "*sifanicus*"; the relative proportions are as follows:

Skins alone,	8 <i>berezovskii</i> to 5 <i>sifanicus</i>
Skulls alone	8 <i>berezovskii</i> to 3 <i>sifanicus</i>
Total	17 <i>berezovskii</i> to 8 <i>sifanicus</i> , approx. 2:1

MUSK-DEER OF BURMA

U Tun Yin (1967) draws attention to the presence of the Musk-deer in Burma. He states that it is found in the snow-covered hills round Putao, and generally keeps above 8,000 feet.

There are two specimens in collections seen by me: both skins unaccompanied by skulls. B.M. 50.741, from the Adung-Seingku confluence at 5,000 feet, is a yellow-grey-brown; Bombay no. 17845 from Dchpu L'kha, Putao subdivision, is less greyish, a yellow-brown all over. These colours are quite different from any others seen by me; however Kao's description of *sifanicus* as "sandy yellow or light brown" suggests that they may not be entirely outside the range of this form. The hair patterns are different from those described for *sifanicus*: simply creamy-grey at the base, for four-fifths of the length, then yellow at the tip.

It seems probable that these skins represent *sifanicus*; on present evidence they seem to differ from this species in China, and are certainly very different indeed from Indian and Sikkimese examples; but the

paucity of material from China available outside the Academia Sinica collections, dictates caution in assessing the situation.

NOMENCLATURE

The first problem of nomenclature concerns the name *Moschus moschiferus* Linnaeus, 1758. The entry under this heading is as follows:

29. MOSCHUS. Cornua nulla.

Dentes Laniarii superiores solitarii exserti.

moschiferus. 1. Moschus. Syst. nat. 13.

Animal moschiferum. Ray. quadr. 127.

Capreolus moschi. Gesn. quadr. 695.

Capra moschus. Aldr. bisulc. 743. Jonst. quadr. 55, t. 39.

Moschus. Schröck. monogr. t. 44.

Habitat = Tataria versus Chinam.

Moschus substantia unctuosa ambrosiaca e folliculo prope umbilicum.

Schröcki Historia moschi. Wien 1682. quart.

Flerov (1928), going on just the "Tataria versus Chinam" part, nominated the Russian Altai as the type locality. Such a fixation would be acceptable could it be shown that no contrary evidence exists; even though Flerov himself later (1952) reduced its authority by giving a new "type locality" (northern India). It is necessary to go into Linnaeus's sources to see whether any localities or detailed descriptions are to be found there.

The first source, Ray (1693), gives quite a long description in Latin, which is taken directly from Grew (1681). The latter is a splendidly discursive description of the oddities and curios at that time in the possession of the Royal Society—among them, a stuffed Musk-deer. The description begins, "He breeds in *China*, and the *East Indies* . . ." and goes on to give quite a detailed description of the specimen. He at no time, however, says what colour it actually is; and, while saying that the ears are like a coney's, about three inches long, and erect (in a stuffed specimen, mind you!), he does not describe their colour either. (I suppose that, if this could be taken as negative evidence, it indicates that *sifanicus*, with its parti-coloured ears, is not in question).

Linnaeus's next three sources—Gesner, Aldrovandus and Johnstonus—are extremely unspecific and seem to confuse different animals under the same heading: the latter two even award the Musk-deer two horns! They are clearly unusable as far as taxonomy is concerned.

Schröckio (1682), Linnaeus's final reference, quoted also by Ray, is a very interesting book on musk—its source, extraction, uses and so

on. His data on the Musk-deer are all Chinese; he gives the generalised Mandarin name, *Xe* (usually transliterated *She* today) and its variant *Xehaing* (probably the same as Kao's *Chang*, used in Szechwan); and quotes, among others, Marco Polo, who supplies the only thing approaching a locality—"de regione Tebeth et Caniclu" (perhaps Kansu?). Fascinating though all this is, it really amounts to hearsay as far as the animal itself is concerned. Which throws us back onto the description of the stuffed musk-deer in the Royal Society.

The Royal Society's collection was presented to the British Museum in June, 1781; according to Thomas (1906) very few specimens in the BM (NH) collections can now be identified as coming from this source. The only specimen of *Moschus* whose source is not known is a skull, 676 k, said to be "from a skin in the old museum stores" according to the register. This is precisely where the Royal Society specimens would have ended up; but alas, the skull in question is female, whereas Grew clearly describes the sharp hooked tusks of the Royal Society specimen. I am indebted to Dr Alan Gentry of the Mammal Section, BM (NH), for discussions and correspondence on this matter.

The only part of Grew's description which could be diagnostic is the section describing the individual hairs: the hair on the back and buttock is

3 inches long... brown and white portions alternately from root to top.

The hair patterns of the three species of *Moschus* were described above. Only the Siberian musk-deer (the one provisionally called *M. moschiferus* above) has white rings on the hair: in both the other species the rings tend to be yellowish to some degree. If, therefore, Grew's description is accurate, then it seems to have been a Siberian musk-deer; also, 3 inches (77 mm) is a length approached more nearly by the Siberian species than by the other two. Accordingly Flerov is likely to have been right in 1928 and 1930, wrong in 1952, and his fixing of the type locality in 1928 as the Russian Altai may be accepted as being without demonstrable contradiction.

The earliest name for musk-deer from the Indian region is Hodgson's *Moschus chrysogaster* (1839). The localities of Hodgson's specimens have been discussed in a previous paper (Groves & Mazák 1967); the early date of Hodgson's specimen, together with those named *leucogaster* and *saturatus* at the same time, give no reason to doubt that they could really be from some part of Nepal. It has been shown above that all three type specimens are referable to the "cf. *berезовskii*" type of Indian musk-deer; as they antedate Flerov's name by nearly ninety years, they must take preference, the name *chrysogaster* being the first name for the "forest musk-deer"; this name was selected from the three by Flerov (1928) in his capacity as First Reviser, even though he used it incorrectly. It will be seen from Table 1 that, if skulls of this species

are correctly determined, then the Indian race is significantly larger and longer-faced than the Chinese, so that the name *berezovskii* remains valid at the subspecific level.

For the "horse musk-deer" (Kao), or, better, "Alpine musk-deer", it seems that the name *sifanicus* is the only one ever to have been applied. The Indian race differs in coloration from the Chinese, especially in the pattern on the ears; but until the differences can be specified with more accuracy, and the position of the Burmese form elucidated, it will be better not to designate the Indian race with a name beyond simply *Moschus sifanicus* subsp.

TAXONOMIC CONCLUSIONS

A list of the taxa of the genus *Moschus* considered valid on the basis of the present study, follows below. Full references will be found in Ellerman and Morrison-Scott (1951).

1. MOSCHUS MOSCHIFERUS Linnaeus, 1758. Siberian musk-deer.

M. m. moschiferus Linnaeus, 1758. Siberia (see Heptner *et al.*, 1961); northern Heilungkiang province, China.

M. moschiferus Linnaeus, 1758. Russian Altai (Flerov, 1928).

M. sibiricus Pallas, 1779. Above Abakan (53.43 N, 91.25 E), Russian Altai.

M. altaicus Eschscholtz, 1830. Mongolian Altai.

M. m. maculatus, fasciatus and *concolor* Gray, 1872 (ex Milne-Edwards, 1864). Siberia.

M. m. arcticus Flerov, 1928. Mt. Toulaiakh-kaia, northeastern Taskhaiakh-takh range, 68.00 N, 139.00 E, Siberia.

M. m. parvipes Hollister, 1911. Korea, Primorskii Krai, Kirin, southern Heilungkiang.

M. parvipes Hollister, 1911. Mok-po (34.50 N, 126.25 E), S. Tscholla province, Korea.

M. m. turowi Zalkin, 1945. Terney Bay (45.40 N, 136.36 E), Sikhote Alin Reserve.

M. m. sachalinensis Flerov, 1928. Sakhalin island.

2. MOSCHUS CHRYSOGASTER, Hodgson, 1839. Forest musk-deer.

M. c. chrysogaster Hodgson, 1839. Wooded slopes of Himalayas in India, Nepal and Sikkim (and Bhutan?).

M. chrysogaster, leucogaster and *saturatus* Hodgson, 1839. Nepal.

M. cacharensis Lydekker, 1915. (ex Hodgson ms.). nom. nud., Kachar.

M. c. berezovskii Flerov, 1928. Wooded slopes of southern China.

M. berezovskii Flerov, 1928. Ho-tsi-khow pass, Sikou, 33.50 N, 104.23 E, Szechwan.

M. chrysogaster subsp. uncertain; ?Kwangsi.

3. *MOSCHUS SIFANICUS* Büchner, 1891. Alpine musk-deer.

M. s. sifanicus Büchner, 1891. Alpine zone of Tibetan plateau region.

M. sifanicus Büchner, 1891. S. Kansu (Hsifan zone).

M. sifanicus subsp. (*M. chrysogaster chrysogaster* of Flerov, 1928; *M. mochiferus moschiferus* of Flerov, 1952). India, Nepal and Sikim.

M. sifanicus subsp. Burma.

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SKULL MEASUREMENTS OF *Moschus* spp.

	Greatest length			Lacrimal length			Lacrimal breadth			Source
	Mean	S.D.	n.	Mean	S.D.	n.	Mean	S.D.	n.	
MOSCHUS MOSCHIFERUS										
<i>M. m. moschiferus</i>										
Teletskoye Lake	150.8	3.21	14	20.4	1.55	14	19.4	1.03	14	1a
Tokko River	156.6	2.85	8	—	—	—	—	—	—	2
Verkhoyansk Ra.	153.2	2.12	3	—	—	—	—	—	—	2
I-ch'un	155.7	—	2	14.6	—	2	19.5	—	2	3
<i>M. m. parvipes</i>										
S. Manchuria	144.8	3.34	9	14.4	0.96	11	18.9	1.91	11	3
Korea	145.4	—	2	—	—	—	—	—	—	4
MOSCHUS CHRYSOGASTER										
<i>M. c. berezovskii</i>										
Szechwan	146.4	4.89	6	20.5	2.72	7	19.7	1.87	7	3,5
Szechwan	145.0	2.85	9	19.4	1.32	9	21.6	2.07	9	8
Shensi, Ichang	141.5	—	2	17.7	0.52	3	18.9	2.01	3	1b,3,6
<i>M. c. subsp.</i>										
Kwangsi	118.9	—	2	14.8	—	1	18.9	—	1	3,7
MOSCHUS SIFANICUS										
Cachar	150.0	—	1	22.0	—	1	19.0	—	1	1b
Sikkim, Nepal	150.0	1.83	4	24.8	0.50	4	18.5	0.58	4	1b
Kulu, Kashmir	154.3	4.04	3	25.5	1.00	4	20.3	0.96	4	1b,1c
MOSCHUS SIFANICUS										
<i>M. s. sifanicus</i>										
China	161.8	4.87	9	23.4	3.16	10	18.6	1.28	10	3,1d
Shigatse	163.0	—	1	25.0	—	1	23.0	—	1	1b
<i>M. s. subsp.</i>										
India, Nepal	160.4	3.58	5	26.2	0.84	5	19.6	1.52	5	1b